

# **SURFACE WATER**

## **Improvement and Management (SWIM) Plan**

**Update for  
Lake Okeechobee  
2002**



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# **Lake Okeechobee Surface Water Improvement and Management (SWIM) Plan**

## **Planning Document**



**July 2002 Draft**

**prepared by**

**South Florida Water Management District  
West Palm Beach, Florida**



## EXECUTIVE SUMMARY

This document provides an overview of the activities and accomplishments that have been directed towards the restoration of Lake Okeechobee since adoption of the *Surface Water Improvement and Management (SWIM) Plan - Update for Lake Okeechobee* (SFWMD, 1997a). This update also describes the current and proposed activities through 2000.

Lake Okeechobee and its watershed are key components of South Florida's Kissimmee-Okeechobee-Everglades ecosystem, which extends from the headwaters of the Kissimmee River in the north to Florida Bay in the south. The lake provides a number of ecological and societal values. It is home to one of the nation's prized bass and speckled perch fisheries, as well as an economically important commercial fishery. At the same time, it provides habitat for a wide variety of wading birds, migratory waterfowl, and the federally-endangered Everglades Snail Kite. Lake Okeechobee is also a source of drinking water for cities and towns along the lake, and can be a backup water supply for the communities of the lower east coast of Florida. The lake also supplies irrigation water for the expansive Everglades Agricultural Area, and is a critical supplemental water supply for the Everglades.

The Lake Okeechobee SWIM planning area has been defined as the major basins that are direct tributaries to the lake, including those basins that are hydrologically upstream and/or from which water is presently released or pumped into the lake on a regular basis. Although the Lake Okeechobee SWIM planning area generally excludes basins that are hydrologically downstream and act primarily as receiving basins for water supply (Caloosahatchee and St. Lucie River), the conveyance of flood control discharges and the resulting potential associated environmental impacts make these basins a component of this plan.

The SWIM Act (Section 373.451-.459, Florida Statutes, [F.S.]), adopted by the Florida Legislature in 1987, requires water management districts, in conjunction with other state agencies and local governments, to prepare SWIM Plans for priority water bodies, including Lake Okeechobee. The SWIM Act requires that the plans describe strategies and potential programs for restoring or protecting the water body to Class III standards or better for recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The plan must include a listing of studies that are being or have been prepared for the water body; a description of the research and feasibility studies that will be performed to determine the particular strategy or strategies to restore or protect the water body; a description of the measures needed to manage and maintain the water body once it has been restored and to prevent future degradation; a schedule for restoration and protection of the water body; and an estimate of the funding needed to carry out the restoration or protection strategies.

The SWIM Act sets forth a specific process for the preparation, review, and approval of SWIM Plans. It requires the South Florida Water Management District

(SFWMD or District) to develop SWIM plans in cooperation with the Florida Department of Environmental Protection (FDEP) and other agencies. Pursuant to Section 373.455, F.S., the District submits a draft plan to the FDEP and other agencies. The FDEP reviews the cost of the SWIM Plan, funding availability, and the likelihood that the plan will significantly improve or protect water quality and associated natural resources. If the FDEP determines that a SWIM plan does not meet minimum plan requirements, it shall recommend to the District modifications or additions to the plan pursuant to Section 373.456(1), F.S. Other agencies review the plan for its effects on the resources within their respective jurisdictions and make recommendations.

SWIM plans must be consistent with state water policy as outlined in Chapter 62-40, Florida Administrative Code (F.A.C), and to otherwise provide guidance to the FDEP and the water management districts in the development and preparation of water management programs, rules, and plans. Chapter 62-40.432 requires the water management districts to develop pollution load reduction goals (PLRGs) for SWIM water bodies. The PLRG developed for Lake Okeechobee was a 40 percent reduction in phosphorus loading from the watershed, based on the conditions that existed from 1973 to 1979 (Federico et al., 1981), with an expected downstream benefit of maintaining the trophic state and the biological integrity of the lake. To assist in achieving this goal, total phosphorus concentrations in runoff leaving land parcels were limited by the Lake Okeechobee Works of the District (WOD) Rule. The total phosphorus concentration targets range from 0.18 to 1.2 milligrams per liter (mg/l).

The federal Clean Water Act (Title 33, Chapter 26, Subchapter III, Section 1313(d)), requires that each state develop total maximum daily loads (TMDLs) for each water-quality-limited segment reported. A TMDL reflects the total pollutant loading, from all contributing sources, that a water segment can receive without exceeding its capacity to assimilate the pollutant loads and still meet applicable water quality standards. The phosphorus TMDL established for Lake Okeechobee is 140 metric tons (based on a 5-year rolling average) to achieve an in-lake target phosphorus concentration of 40 parts per billion in the pelagic zone of the lake (FDEP 2000). The restoration target was determined using computer models developed based on past research performed by the SFWMD using SWIM funds. This target will support a healthy lake system, restore the designated uses of Lake Okeechobee, and allow the lake to meet applicable water quality standards.

The 1997 SWIM plan update reported that phosphorus load reductions had occurred, but the 40 percent reduction in loads was not achieved. It recommended the implementation of programs and projects to improve the lake and watershed water quality situation. The status of these programs and projects are summarized in this update. Even with the implementation of these programs and projects, nutrient loads to Lake Okeechobee have not decreased significantly. The highest inflow phosphorus concentrations continue to be found in the S-154 and S-191 basins where dairies are abundant and the majority of the out-of-compliance WOD sites are found. Phosphorus loading is far in excess of the amount considered for a healthy Lake Okeechobee ecosystem and current model data predict that it may take decades before in-lake phosphorus concentrations will respond to reduced external loads.



Several major accomplishments have been made in the restoration effort since the publication of the last SWIM plan update in 1997. One of the most important restoration actions was the Lake Okeechobee Managed Recession Operation. During six years prior to 2000, high water levels in the lake (associated with a prolonged wet period) destroyed nearly all of the lake's submerged plant beds and caused extremely poor water quality. The lake's prize bass fishery was on the brink of ecological collapse. A period of low water levels (less than 13 feet, lasting for at least 8 weeks) was required to allow recovery of the biological communities. In April and May 2000, approximately one foot of water was released from Lake Okeechobee. Coincident with that, another one foot of water left the lake for normal water supply deliveries to agriculture and other uses, and one foot left the lake by direct evaporation into the atmosphere. Taken together the lake dropped by approximately 3 feet between April and July. As a result of the low water levels, Lake Okeechobee quickly recovered from its previously stressed condition. Over 45,000 acres of new submerged plant beds grew during the summer and fall and the lake's nearshore bulrush community (prime bass habitat) expanded. The low water levels also allowed coordinating state and federal agencies to carry out controlled fires that have killed tens of thousands of acres of exotic plants that were taking over valuable wildlife habitat.

A new regulation schedule for the lake was formally adopted by the United States Army Corps of Engineers (USACE) in July 2000. This schedule, the Water Supply and Environment (WSE) schedule uses climate forecasting to determine the volumes of water to release from the lake under flood control circumstances, and has the potential to provide environmental benefits for the lake and downstream systems while not sacrificing water supply. The extent of the benefits will depend in part on specific adaptive management protocols that are presently being developed by the District.

Restoration efforts for Lake Okeechobee were recently advanced with the passing of the Water Resources Development Act of 2000 (WRDA 2000). The WRDA 2000 authorizes the Comprehensive Everglades Restoration Plan (CERP). The CERP is expected to have substantial effects on the lake's hydropattern. It is expected to reduce the number of extreme high and low events and increase the occurrence of ecologically beneficial spring recession events. The act also authorizes projects that will reduce nutrient loads to the lake. These components include regional stormwater treatment areas, reclamation of isolated wetlands, and regional water storage facilities, such as aquifer storage and recovery wells and reservoirs.

The enactment of the Lake Okeechobee Protection Act (LOPA) (Section 373.4595, F.S.) in 2000 also advanced restoration efforts. This act provides an umbrella that captures many lake restoration efforts. It will significantly enhance mandates restoring and protecting the lake using a phased, watershed-based approach to reduce phosphorus loading to the lake and downstream receiving waters. Fulfilling this act will require a great deal of cooperation among government agencies and the public. To facilitate the execution of the Lake Okeechobee Protection Plan, an interagency committee was formed with individuals from the FDEP, the Florida Department of Agriculture and Consumer Services, and the SFWMD. The agencies are currently planning and implementing numerous management activities in the watershed to reduce phosphorus loading to the lake. These include the construction of surface water storage reservoirs and stormwater

treatment areas; the restoration of isolated wetlands the development and implementation of best management practices to control nonpoint sources of pollution; the continuation of research and monitoring to ensure the projects are designed and implemented to optimize success; the removal of phosphorus-rich sediment from tributaries to Lake Okeechobee; and the implementation of a sediment management feasibility study to determine whether or not it is feasible to reduce internal loading from the lake sediments. More current information regarding the status of the LOPA activities can be found in the *Lake Okeechobee Protection Program Annual Report to the Legislature* (SFWMD, 2001a, 2001b).

This update of the Lake Okeechobee SWIM Plan has set goals for the Lake Okeechobee SWIM planning area in the areas of water quality; environmental resources; flood protection and water supply; recreation, navigation, and public involvement; and intergovernmental coordination. Objectives have been developed to accomplish these goals. Programs and projects are being developed and will be implemented to achieve these objectives. The goals and objectives, as well as some of the programs and projects are summarized below.

## **Phosphorus Load Reduction in the Tributaries**

In an effort to meet the proposed TMDL target and in-lake phosphorus concentration of 40 parts per billion and achieve a phosphorus load of 140 tons per year, over-target phosphorus loading must continue to be reduced. The expanded WOD program, the new Lake Okeechobee Protection Plan, and other new programs and projects are being implemented to achieve the inflow target are summarized in **Chapter 2** and itemized below:

- Best available technologies to significantly reduce the export of phosphorus from dairy operations into tributaries and Lake Okeechobee
- Reservoir-assisted stormwater treatment areas
- Critical restoration projects
- Isolated wetlands restoration
- Natural resource economic analysis of a wide range of phosphorus control alternatives, using full-cost accounting practices
- Sediment removal technologies in the tributaries
- Research and modeling efforts to determine source of loads and methods to reduce them



## Reduction of Nonnutrient Pollutant Loads

To reduce the nonnutrient pollutant loads, Class I Water Quality Standards (potable water supplies) must be achieved within Lake Okeechobee and Class III Water Quality Standards must be achieved within the lake tributaries. To achieve the in-lake reduction, the following initiatives are planned, and are detailed in **Chapter 3**:

- The District will continue monitoring to ensure the water quality requirements of the Lake Okeechobee Operating Permit are fulfilled.
- Both the District's monthly water quality monitoring program and its organics and pesticide monitoring program will be modified to focus resources on parameters that are known to have potential sources in the watershed.
- The applicability of additional management strategies for canals and marinas will be determined.

## Reduction of In-Lake Nutrients

Due to an overabundance of nutrients in Lake Okeechobee, a process known as eutrophication, large algal blooms have periodically formed in Lake Okeechobee. Algal blooms are cause for concern because they may contain toxins that affect fish and wildlife; they create taste and odor problems for drinking water; and when they die off and degrade, oxygen is removed from the water column and waste products (e.g., ammonia) accumulate, causing fish kills and the death of other aquatic life. Lake users also find these blooms unsightly, reducing their enjoyment of the resource.

In-lake phosphorus must be reduced to attain a more natural, lower frequency of potentially harmful algal blooms. To achieve this goal the SFWMD will do the following:

- Evaluate the feasibility of removing phosphorus-rich sediments from the lake
- Evaluate the feasibility of chemical treatment of lake sediments to "inactivate" the phosphorus
- Identify lake stage management options that would facilitate greater coverage of submerged plants, and thus, greater phosphorus uptake
- Complete research and model development necessary to guide the most effective phosphorus reduction efforts, as called for in the Lake Okeechobee Protection Plan

## Environmental Resources

Another goal of the Lake Okeechobee SWIM Program is to protect and enhance the lake's environmental resources. These resources include biological diversity, ecological functions, and the distribution and abundance of native plants and animals. The following objectives have been set to fulfill the environmental resource goal:

- Identification of a range of water levels that will allow for a healthy community of submerged and emergent native plants and the communities of fish and wildlife that they support
- Identification and implementation of effective programs to control exotic plants, including melaleuca and torpedograss
- Various in-lake habitat restoration projects carried out jointly with the Florida Fish and Wildlife Conservation Commission (FWC)

Given the amount of public dollars that are being spent on the restoration of Lake Okeechobee, it is critical that we be able to track changes in the health of the ecosystem both for 1) documentation of success, and 2) feedback to managers so that, if necessary, management strategies can be modified. This “adaptive assessment” strategy mirrors the approach being used in the CERP, and it includes long-term monitoring of a comprehensive set of ecological performance measures in the lake. These performance measures include submerged and emergent plants; plankton and macro algae; benthic invertebrates; and fish. The program involves coordinated efforts between the District and the FWC.

Preserving and enhancing critical habitats or areas to protect sensitive communities and/or rare, threatened, or endangered species is another of the environmental resource objectives for Lake Okeechobee. To fulfill this objective, the District will continue restoration evaluation efforts under the Kissimmee River Restoration Project and will coordinate with state and federal agencies to complete the implementation of the *South Florida Multispecies Recovery Plan* in conjunction with the CERP.

The long-term goal, under the CERP, is to have hydrologic conditions that include fewer extreme high water level events in the lake and fewer damaging discharges to the estuaries. In the interim, until the CERP is completed, we aim to minimize (to the extent possible with the existing system) those impacts by careful use of the WSE schedule, including adaptive management protocols that are driven by the needs of downstream systems for fresh and salt water. Those needs have been identified by an ongoing program of research, largely funded with SWIM dollars.

## **Flood Control and Water Supply**

The flood control and water supply goals for the Lake Okeechobee SWIM planning area are as follows:

- Ensure adequate flood protection to local communities and agriculture around the lake
- Provide a balance between the competing objectives of flood protection, water supply, and protection of the lake’s marsh zone and downstream estuaries

- Maintain an adequate quantity of water in Lake Okeechobee to supplement downstream environmental needs and reasonable-beneficial use requirements

The District will fulfill two objectives to ensure adequate flood protection for the Lake Okeechobee SWIM planning area. The first objective is to ensure design capacity of the Central and Southern Florida Project is met. The second objective is to continue reducing the Everglades Agricultural Area's dependency on the lake and the water conservation areas for flood control. The District will also assist local governments in addressing flood protection in their comprehensive plans.

As the local sponsor of the CERP and the Lake Okeechobee regulation schedule, the District must provide a balance between the competing objectives of flood protection, water supply, and protection of the lake's marsh zone and downstream estuaries. To maximize the extent to which this balance is achieved prior to completion of the CERP, District and other agency scientists are working with operations specialists to identify environmental "triggers" that can be used in the process of the WSE regulation schedule for determining amounts of water to release from the lake under flood control conditions. Information from the long-term ecological assessment program, described above, will be supportive of this process, by providing information on ecological status of the lake at any given time. As noted, information on declining lake health was a major driving force for the Lake Okeechobee Managed Recession Operation in 2000. Results from ongoing experimental research with the lake's submerged plant communities is also defining a "stage envelope" necessary to support this important resource, much like the "salinity envelope" that was recently developed for the St. Lucie Estuary to protect its biota. This information will be core to the scientific input in support of water release triggers under WSE.

The District must ensure Lake Okeechobee has an adequate quantity of water to supplement downstream environmental, urban, and agricultural needs, and to recharge the coastal aquifer. To determine the overall water supply demand that will be made on the lake, the urban and agricultural water supply needs must be updated regularly and the environmental water needs for the downstream environment, as well as the role of Lake Okeechobee in meeting them, must be determined. Also, water supply demands need to be reduced. The District has developed and is implementing programs and projects that will reduce some of these demands including implementing and improving the *Lake Okeechobee Supply-Side Management Plan* (Hall, 1991).

## Recreation

The District's goal for recreation within the Lake Okeechobee SWIM planning area is to attain recreational opportunities that meet public demand and are consistent with other SWIM goals. The District is achieving this goal by managing Lake Okeechobee in an effort to optimize opportunities for growth of native vegetation and enhance the health of the lake's fisheries and associated recreational opportunities such as sport fishing, boating, ecotourism, and tournaments.

## **Navigation**

The Lake Okeechobee SWIM goals for navigation are to assist the USACE in maintaining navigability for commercial and recreational uses within Lake Okeechobee, the Lake Okeechobee Waterway, and recreational uses within the Kissimmee River. These goals are achieved by maintaining water storage in Lake Okeechobee, maintaining navigation locks and structures, and controlling aquatic weeds. With the restoration of the Kissimmee River under way, special consideration must be given to the changing navigation conditions that are occurring on the river with the removal of structures and locks, and the resulting low water conditions.

## **Public Involvement and Intergovernmental Coordination**

The public involvement and intergovernmental coordination goals for the Lake Okeechobee SWIM planning area are to prepare and implement an effective public awareness program and an effective intergovernmental awareness and involvement program. These programs will encourage public participation in the Lake Okeechobee SWIM planning process.

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## ACRONYMS AND ABBREVIATIONS

<b>°C</b>	degrees Celsius
<b>ASR</b>	aquifer storage and recovery
<b>BAT</b>	best available technologies
<b>BMP</b>	best management practice
<b>C&amp;SF</b>	Central and Southern Florida
<b>CaCO<sub>3</sub></b>	calcium carbonate
<b>CDS</b>	continuous deflective separation
<b>CERP</b>	Comprehensive Everglades Restoration Plan
<b>cfs</b>	cubic feet per second
<b>DDD, p,p'</b>	dichlor diphenyl dichlor
<b>DDE, p,p'</b>	dichlor diphenyl ethylene
<b>DDT</b>	dichlor diphenyl trichlor
<b>District</b>	South Florida Water Management District
<b>EAA</b>	Everglades Agricultural Area
<b>EAAMOD</b>	Everglades Agricultural Area Model
<b>EPD</b>	Everglades Protection District
<b>F.A.C.</b>	Florida Administrative Code
<b>FDACS</b>	Florida Department of Agriculture and Consumer Services
<b>FDCA</b>	Florida Department of Community Affairs
<b>FDEP</b>	Florida Department of Environmental Protection
<b>FDOT</b>	Florida Department of Transportation
<b>FHANTM</b>	Field Hydrologic and Nutrient Transport Model
<b>FTA</b>	Florida Trail Association
<b>F.S.</b>	Florida Statutes
<b>FWC</b>	Florida Fish and Wildlife Conservation Commission
<b>GIS</b>	geographic information system
<b>ha</b>	hectare
<b>HIA</b>	high-intensity use area
<b>IFAS</b>	Institute of Food and Agricultural Sciences
<b>kg</b>	kilogram

<b>km</b>	kilometer
<b>LEC</b>	Lower East Coast
<b>LOADSS</b>	Lake Okeechobee Agricultural Decision Support System
<b>LOHSTM</b>	Lake Okeechobee Hydrodynamic and Sediment Transport Model
<b>LOPA</b>	Lake Okeechobee Protection Act
<b>MFL</b>	minimum flows and levels
<b>mgd</b>	million gallons per day
<b>mg/l</b>	milligrams per liter
<b>NGVD</b>	National Geodetic Vertical Datum
<b>NPDES</b>	National Pollution Discharge Elimination System
<b>NRCS</b>	Natural Resources Conservation Service
<b>PAM</b>	permit addendum modification
<b>PCA</b>	phosphorus control alternatives
<b>PLRG</b>	pollution load reduction goals
<b>ppb</b>	parts per billion
<b>ppm</b>	parts per million
<b>ppt</b>	parts per thousand
<b>RCRC</b>	Resource Conservation and Recovery Act
<b>Restudy</b>	Central and Southern Florida Project Comprehensive Review Study
<b>SFWMD</b>	South Florida Water Management District
<b>SOR</b>	Save Our Rivers
<b>STA</b>	stormwater treatment area
<b>SWIM</b>	Surface Water Improvement and Management
<b>TMDL</b>	total maximum daily loads
<b>TST</b>	tributary sediment trap
<b>µg/l</b>	micrograms per liter
<b>USACE</b>	United States Army Corps of Engineers
<b>USEPA</b>	United States Environmental Protection Agency
<b>USFWS</b>	United States Fish and Wildlife Service
<b>USGS</b>	United States Geological Survey
<b>WCA</b>	water conservation area
<b>WMA</b>	wildlife management area
<b>WOD</b>	Works of the District



**WSE**                      Water Supply and Environmental

